Draft

Total Maximum Daily Load

For

Dissolved Oxygen

In

New River, WBID 1442, Florida

Prepared by:

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Region 4
Atlanta, GA

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DRAFT SUMMARY SHEET
Total Maximum Daily Load (TMDL)

1. **303(d) Listed Waterbody Information**
   State: Florida
   County: Hillsborough
   Major River Basin: Tampa Bay Basin (HUC 03100205)

Waterbody (List ID)	Listing Year	Impairment(s)	Pollutant(s)
New River (WBID 1442)	**1998**	**Dissolved Oxygen**	**None-Natural wetland DO consumption**

2. **TMDL Endpoints (i.e., Targets) for Class III Waters (fresh):**

Dissolved Oxygen (DO) shall not be less than 5.0 milligrams/L. Normal daily and seasonal fluctuations above these levels shall be maintained.

3. **Allocations for WBID 1442**

Parameter	TMDL (lb/day)	WLA		LA (lb/day)	MOS (lb/day)
		Continuous (lb/day)	MS4 (lb/day)		
Dissolved Oxygen (DO)	65.03	0.0	0.0	59.13	5.9

4. **Endangered Species (yes or blank):**

5. **EPA Lead on TMDL (EPA or blank):** EPA

6. **TMDL Considers Point Source, Nonpoint Source, or both:** Both

7. **Major NPDES Discharges to surface waters addressed in EPA TMDLs: none**

INTRODUCTION

The U.S. Environmental Protection Agency is proposing this Total Maximum Daily Load (TMDL) for New River (WBID 1442) as required by the 1999 Consent Decree in Florida Wildlife Federation, Inc., et al. v. Browner, et al., Northern District of Florida, Civil Action No. 4: 98CV356-WS.

The U.S. Environmental Protection Agency (EPA) has analyzed the available data and information for this waterbody, and has determined that this waterbody is *likely* not meeting the State of Florida's applicable water quality standard for dissolved oxygen (DO) due to naturally-occurring conditions. If the waterbody is not meeting its applicable water quality standards due to natural conditions, a TMDL would not be necessary nor would it be required by the consent decree. Florida's water quality standards recognize that some deviations from water quality standards occur as the result of natural background conditions, that is, the condition of the water in the absence of man-induced alterations. Florida's water quality standards also set out how the State is to establish the appropriate criteria for an altered waterbody, that is, where it can be demonstrated that the deviations would occur in the absence of any human-induced discharges or alterations to the water body. For such altered waterbodies, the State may establish a site-specific alternative criterion, based upon a similar unaltered waterbody or on historical pre-alteration data.

However, the existing data and information does not provide certainty that the deviations from the DO water quality standard are naturally occurring. EPA is therefore fulfilling its court-ordered commitment by proposing a TMDL for this waterbody. The TMDL, as proposed, indicates that the existing water quality standard for DO is not attainable in this waterbody, and therefore, recommends that the State of Florida establish a site-specific criterion for DO for this waterbody.

In this proposed TMDL, EPA is seeking comments on the technical analysis presented in the TMDL. EPA is also requesting stakeholders to submit any additional data and information related to the causes of non-attainment of the DO water quality standard in this waterbody. If EPA is able to establish that the low DO conditions of the waterbody are due to natural conditions, the TMDL will not be finalized. If, on the other hand, EPA obtains data and information indicating a pollutant to be the cause, EPA will revise the TMDL to reflect this finding.

PROBLEM DEFINITION

New River, WBID 1442 is on the 1998 303 (d) list for low dissolved oxygen, and coliforms. This TMDL will address the DO impairment, and separate documents will cover the TMDLs addressing the other impairments.

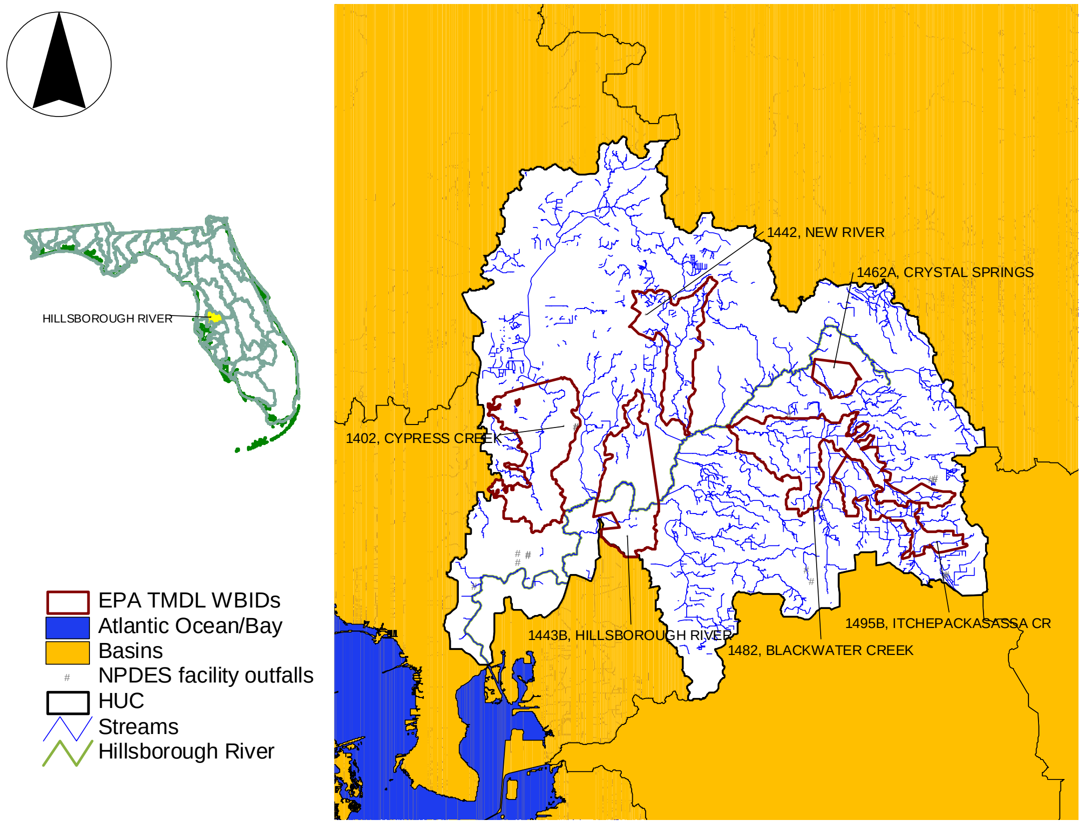

Figure 1: Tampa Bay Tributaries, Impaired WBIDs that EPA is addressing

WATERSHED DESCRIPTION

The FDEP Water Quality Assessment Report describes the Hillsborough River Basin, which begins east-northeast of Zephyrhills and drains 690 square miles before emptying into the upper Hillsborough Bay, as a part of Tampa Bay. Its headwaters originate in the southwestern portion of the Green Swamp, where it also receives overflow from the Withlacoochee River. The river channel is not clearly defined until the river leaves the swamp. From there, it flows southwesterly 54 miles to upper Hillsborough Bay. New River, WBID 1442 is a tributary to the Hillsborough River

WATER QUALITY STANDARD AND TARGET IDENTIFICATION

Florida's surface waters are protected for five designated use classifications, as follows:

Class I	Potable water supplies
Class II	Shellfish propagation or harvesting

Class III	Recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife
Class IV	Agricultural water supplies
Class V	Navigation, utility, and industrial use (there are no state waters currently in this class)

Waterbodies in the Hillsborough River Basin are classified as freshwater Class III waters, with a designated use classification for recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife. The water quality criteria for protection of Class III waters, are established by the State of Florida in the Florida Administrative Code (F.A.C.), Section 62-302.530. The individual criteria should be considered in conjunction with other provisions in water quality standards, including Section 62-302.500 F.A.C. [Surface Waters: Minimum Criteria, General Criteria] that apply to all waters unless alternative or more stringent criteria are specified in F.A.C. Section 62-302.530. In addition, unless otherwise stated, all criteria express the maximum not to be exceeded at any time. The specific criteria are as follows:

Nutrients

The discharge of nutrients shall continue to be limited as needed to prevent violations of other standards contained in this chapter [Section 62.302 F.A.C.] In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora and fauna [Section 62.302530 F.A.C.].

Dissolved Oxygen (DO)

Dissolved Oxygen (DO) shall not be less than 5.0 milligrams/L (mg/L). Normal daily and seasonal fluctuations above these levels shall be maintained.

Biochemical Oxygen Demand (BOD)

BOD shall not be increased to exceed values which would cause dissolved oxygen to be depressed below the limit established for each Class and, in no case, shall it be great enough to produce nuisance conditions.

EXAMINE WATER QUALITY AND ENVIRONMENTAL DATA

The FDEP Water Quality Assessment Report describes that the status of surface water quality in the Tampa Bay Tributaries Basin was determined by evaluating three categories of data; chemistry data, biological data, and fish consumption advisories. The main source of water quality data was information collected between 1996 and 2003 and stored in the EPA's STOrage and RETrieval (STORET) database. Other sources included the FDEP's Biology Database (SBIO) and fish consumption advisory and beach closure information from DOH. In order to develop the TMDL, these data sources and all additional available data was used.

Ambient Water Quality Data

Biological data and chemical water quality data was assessed during the review and listing process. This data is summarized here as background information for the TMDL development. First, the biological data is discussed.

A list of biological assessment results from FDEP's IWR database (FDEP, IWR Database version 16_2, 2004) is shown in Table 1. This shows that New RIver (WBID 1442) scored suspect in 1996 and improved to good in 1998 and 2002.

Table 1: Biological Assessments for the 303(d) listed water bodies.

WBID	Score	Method	Station ID	Station Name	Test Result	Date
1442	Good	SCI	NEWRVTP47	NEW RIVER AT SR579	21	9/14/1998
1442	Healthy	BIORECON	NEWRVTP47	NEW RIVER AT SR579	3	10/2/1995
1442	Suspect	BIORECON	NEWRVTP47	NEW RIVER AT SR579	2	3/14/1996
1442	Good	SCI	NEWRIVER	New River@ Chancey Rd	23	11/20/2002

Next the chemical water quality data is summarized. Tables showing the water quality monitoring stations in each WBID and a summary of the water quality results are shown below.

Table 2: Water Quality Observation Stations used in assessment for New River

Station number	Station Name	First Date	Last Date
21FLTPA281312821558	nr-3 new river	6/26/2002	11/5/2002
21FLTPA280954821553	nr-2 new river	6/27/2002	11/5/2002
21FLTPA24030075	tp47 - new river	2/16/1998	11/5/2002
21FLSWFDFLO0060	new river above hillsborough river	12/10/1992	9/15/1993

New River is on the 303(d) list for Dissolved Oxygen. For fresh waters the dissolved oxygen should not be less than 5.0 mg/L, and for assessments the dissolved oxygen should not be less than 5.0 in more than 10% of the samples.

Table 3: Summary of data for NEW RIVER

Parameter	Obs	Max	Min	Mean	StDev	Violations	Florida Criteria
Dissolved Oxygen (mg/l)	24	6.79	0.31	3.01	2.05	18	5

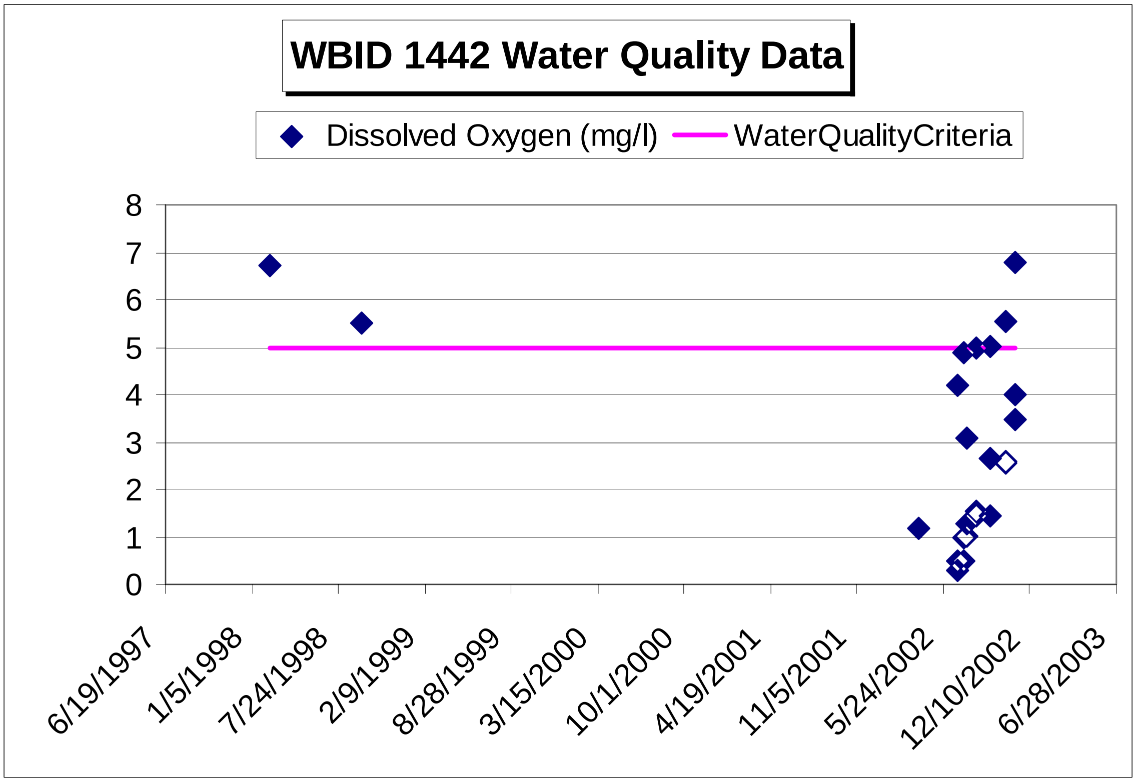

Figure 2: Dissolved oxygen median is 2.61 mg/L

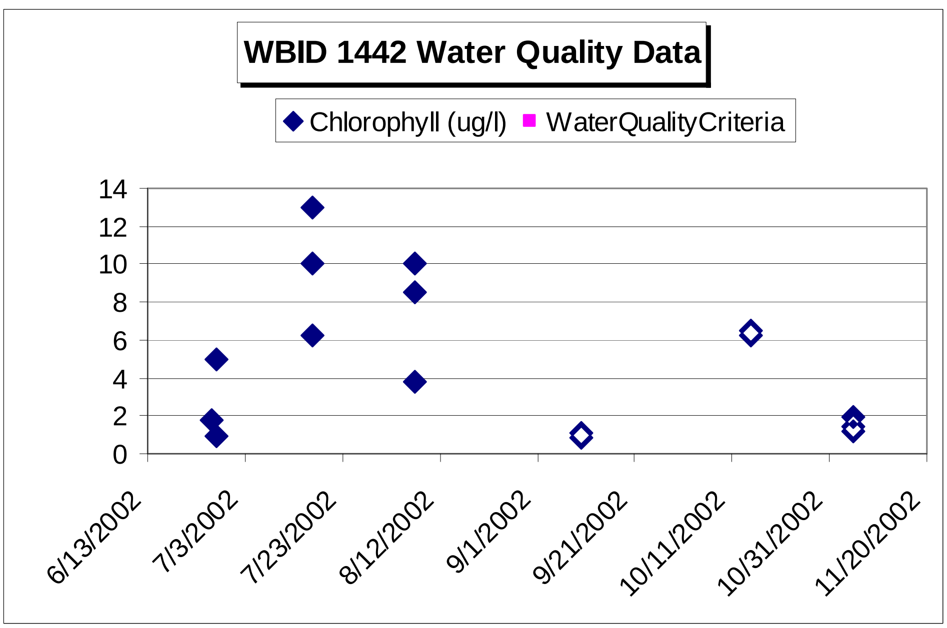

Figure 3: Chlorophyll-a median is 4.4; statewide median ranges from 3 to 4 mg/L

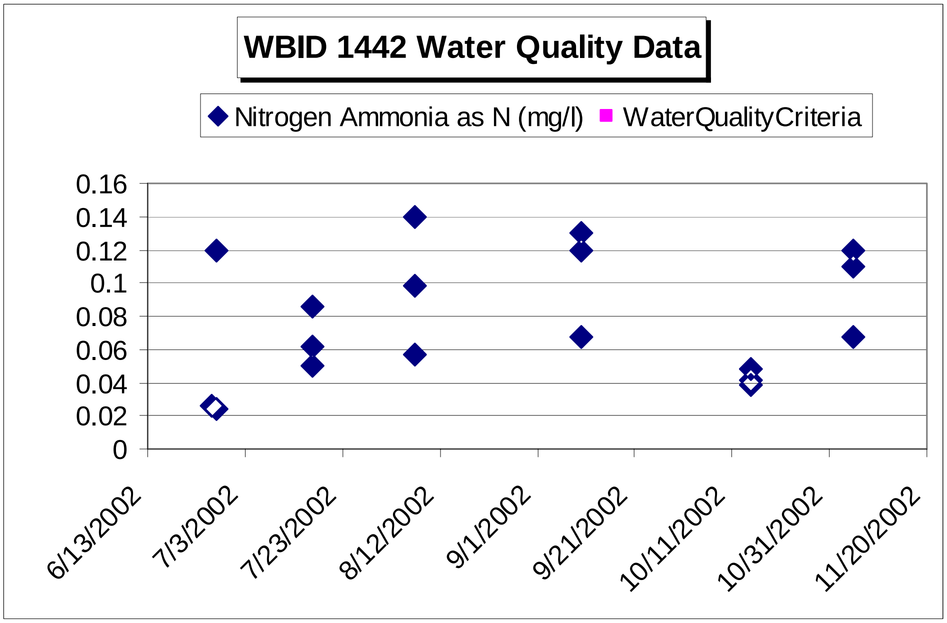

Figure 4: Ammonia nitrogen median is 0.067 mg/L; statewide median is 1.11mg/L

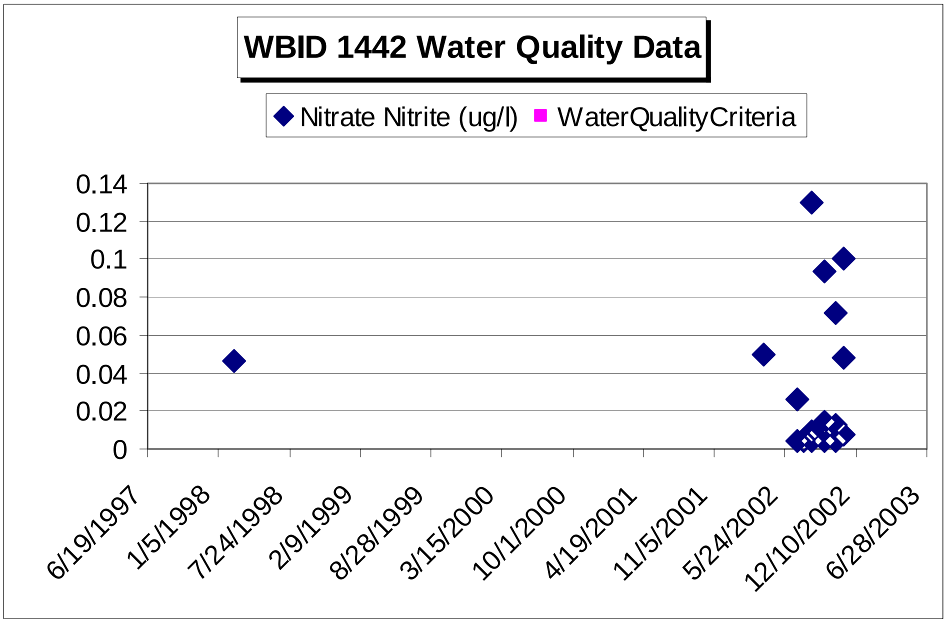

Figure 5: Nitrate plus nitrite median 0.011 mg/L; statewide median is 0.069.

Note: the data in Figure 5 is in mg/L not µg/L

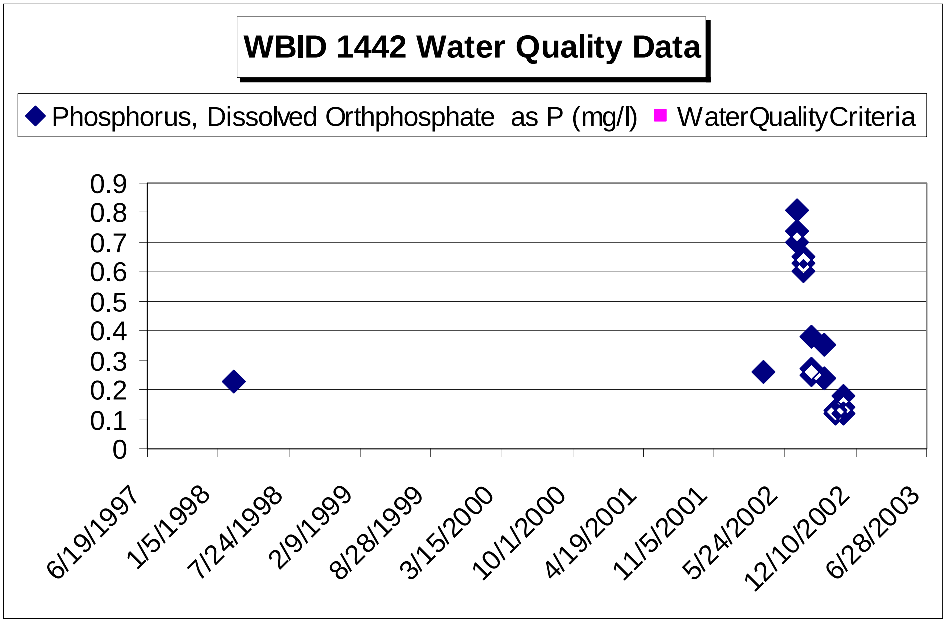

Figure 6: Dissolved orthophosphate median is 0.255 mg/L; statewide median is 0.045

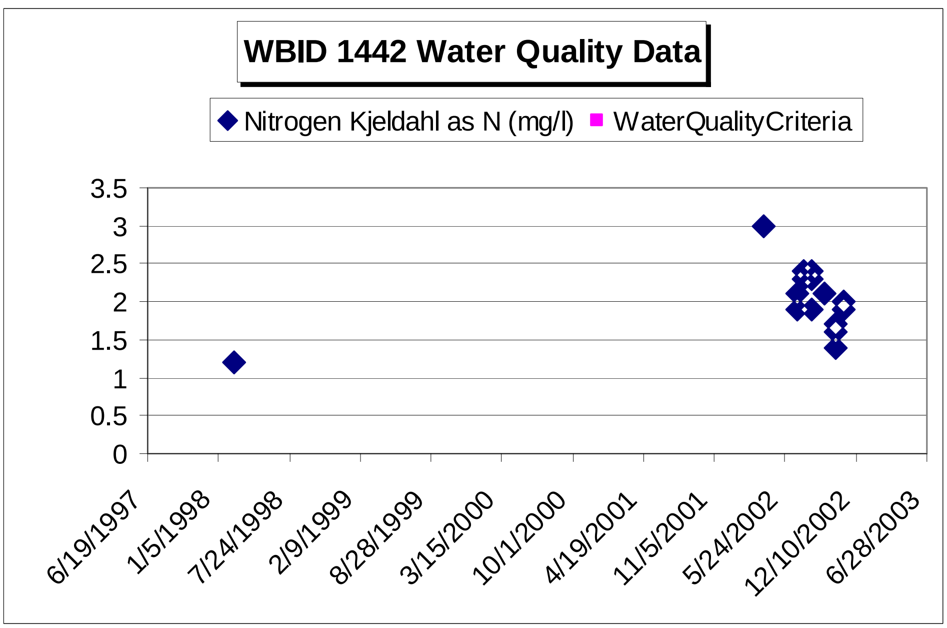

Figure 7: TKN median is 2.05 mg/L; statewide median is 1.1

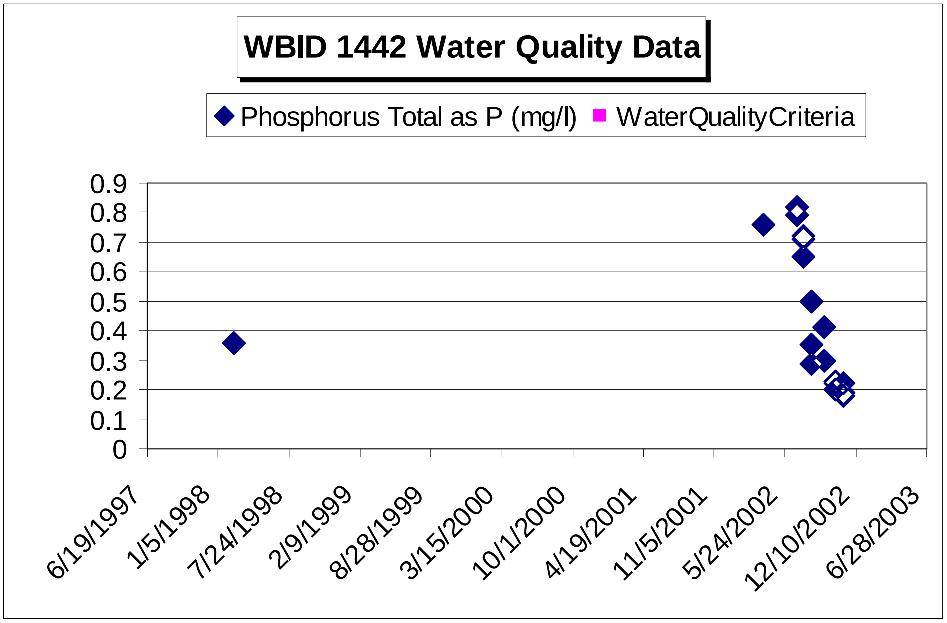

Figure 8: Total phosphorous median is 0.355; statewide median is 0.075 mg/L

Dissolved oxygen (DO) ranges from 0.31 to 6.79 mg/l. Eighteen of 24 (75%) DO samples were below the criterion of 5 mg/l. This percentage is well above the 10% monitoring and assessment threshold that indicates a waterbody is not meeting the DO criteria. However, the biological monitoring data documented in Table 1 indicates that in 1998 and 2002 the New River aquatic community was not impaired. In addition, the New River data show chlorophyll-a has been below 13 ug/l in all samples and the median of the data is 4.4 ug/l. These values are typical of unimpaired Florida streams and would not be sufficient to adversely impact the DO in the stream. No BOD data were recorded in the New River.

Additional analyses of the nutrient data indicate that the median total phosphorus and total nitrogen concentrations are 0.355 mg/l and 2.05 mg/l, respectively. This translates to a nitrogen to phosphorus ratio of about 6, which results in a nitrogen limitation and excess phosphorus in the water. Also, most of the total nitrogen is organic nitrogen and not nitrate- nitrite, less than 0.1 mg/l, indicating that natural decay processes are the likely source of the nitrogen and not application of inorganic nitrate-ammonia fertilizer.

SOURCE ASSESSMENT

An important part of the TMDL analysis is the identification of sources or source categories in the watershed and the amount of pollutant loading contributed by each of these sources. Sources are broadly classified as either point or non-point sources.

A point source is defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. Point source discharges of industrial wastewater and treated sanitary wastewater must be authorized by National Pollutant Discharge Elimination System (NPDES) permits. NPDES permitted facilities including certain urban stormwater discharges such as municipal separate storm sewer systems (MS4 areas), certain industrial facilities, and construction sites over one acre are storm water driven sources that are considered as “point sources” in this report.

Non-point sources of pollution are diffuse sources that cannot be identified as entering a waterbody through a discrete conveyance. These include nutrient runoff of agricultural fields and golf courses, septic tanks, and residential developments outside of MS4 areas.

Table 4: Landuse in acres

WBID	Residential (FLUCCS 1100-1300)	Comm, Ind, public (FLUCCS 1400-1500,1700-1900)	Agriculture (FLUCCS 2100-2600)	Rangeland (FLUCCS 3100-3300)	Forest (FLUCCS 4100-4400)	Water (FLUCCS 5100-5400)	Wetlands (FLUCCS 6100-6500)	Barren &Extractive (FLUCCS 1600,7100-7400)	Transportation and Utilities (FLUCCS 8100-8300)	TOTAL
1442	1167.93	141.02	6894.22	1099.31	1479.61	99.88	2276.80	174.25	26.34	13359.35

Nonpoint sources

Nonpoint sources that ultimately contribute to depletion of in-stream dissolved oxygen include sources of nutrients such as animal waste, waste-lagoon sludge, fertilizer application to agricultural fields, lawns, and golf courses, and malfunctioning onsite sewage treatment and disposal systems or septic tank systems.

The State of Florida Department of Health (www.doh.state.fl.us/environment/statistics) publishes septic tanks data on a county basis. Table 5 summarizes the number of septic systems installed since the 1970 census and the total number of repair permits issued between 1996 and 2001. The data does not reflect septic tanks removed from service.

Table 5: County Estimates of Septic Tanks and Repair Permits (FDEP, 2001)

County	Number of Septic Tanks (2002)	Number of Repair Permits Issued (1996 – 2002)
Hillsborough	100,483	1,651

Landuse in the impaired WBIDs is shown in Table 4. The spatial distribution and acreage of different land use categories were identified using the 1999 land use coverage (scale 1:40,000) contained in the FDEP's GIS library. This dataset was derived from Ifrarred Digital Orthophoto Quadrangle photo interpreatations using the Florida Land Use Classification Code System (FLUCCS). Land use categories in the watershed were aggregated using the FLUCCS Level 2 codes.

Point sources

There are no continuous point sources in the New River basin. However, there are municipal separate storm sewer systems (MS4) throughout the Hillsborough River Basin since the area is extensively developed. The MS4 area in WBID 1442 is Wesley Chapel South.

ANALYTICAL APPROACH/ MODEL SELECTION AND DEVELOPMENT

The New River is a tributary to the Hillsborough River system being modeled for nutrient, BOD, and DO TMDLs. This section documents EPA's attempt to relate pollutant loadings and the observed low DO values in the New River. Only seasonal trends of DO were simulated since DO violations of the standard were observed in the monthly trend monitoring data. The purpose of utilizing water quality models for the development of DO and BOD TMDLs in this stream system is to understand the linkage between the low in-stream DO and the factors that cause the low DO. The models can help determine which factors cause a greater effect than others. Some of the major factors in DO processes include watershed and stream flow and geometry, nutrient loads from the watershed, BOD loads from the watershed, in-stream plants and algae, and sediment oxygen demand.

The major unknowns are the DO concentrations of the water flowing from the watershed into the receiving streams, and the BOD decay rates. Due to the major unknown factors and the limited data, this model application is not intended to predict absolute DO values, but instead to predict the relative effect of nutrients, algae, and BOD on in-stream DO.

Mechanistic Model Approach

WAM was utilized to simulate the watershed hydrology and water quality loads for most of the Hillsborough River Basin. WASP models were set up to examine the DO processes in the Hillsborough River mainstem and the major tributaries Blackwater Creek, Itchepackesassa Creek, Baker Creek, New River, and Cypress Creek. The WAM model was used to predict flows and loads were then linked to the WASP models.

The following summary on of the WAM model is from EPA's Watershed and Water Quality Modeling Technical Support Center web site (http://www.epa.gov/athens/wwqtsc/WAMView.pdf). WAM's interface uses ESRI's ArcView 3.2a with Spatial Analyst 1.1 (or 2.0). WAM was developed to allow engineers and planners to assess the water quality of both surface water and groundwater based on land use, soils, climate, and other factors. The model simulates the primary physical processes important for watershed hydrologic and pollutant transport. The WAM GIS-based coverages include land use, soils, topography, hydrography, basin and sub-basin boundaries, point sources and service area coverages, climate data, and land use and soils description files. The coverages are used to develop data that can be used in the simulation of a variety of physical and chemical processes.

WAM was developed based on a grid cell representation of the watershed. The grid cell representation allows for the identification of surface and groundwater flow and phosphorus concentrations for each cell. The model then "routes" the surface water and groundwater flows from the cells to assess the flow and phosphorus levels throughout the watershed. The model simulates the following elements: surface water and ground water flow allowing for the assessment of flow and pollutant loading for a tributary reach at both the daily and hourly time increment as necessary; water quality including particulate and soluble phosphorus, particulate and soluble nitrogen (NO3, NH4, and organic N), total suspended solids, and biological oxygen demand.

WAM was linked to WASP (SWET, 2003), which enables the simulation of dissolved oxygen and chlorophyll-a. The WAM model simulates the hydrology of the watershed using other imbedded models including "Groundwater Loading Effects of Agricultural Management Systems" (GLEAMS; Knisel, 1993), "Everglades Agricultural Area Model" (EAAMod; Botcher et al., 1998; SWET, 1999), and two submodels written specifically for WAM to handle wetland and urban landscapes. Dynamic routing of flows is accomplished through the use of an algorithm that uses a Manning's flow equation based technique (Jacobson et al., 1998). Attenuation is based on the flow rate, characteristics of the flow path, and the distance of travel. The model provides many features that improve its ability to simulate the physical features in the generation of flows and loadings including:

- Flow structures simulation
- Generation of typical farms
- BMPs
- Rain zones built into unique cells definitions, which also allows use with NEXRAD Data
- Full erosion/deposition and in-stream routing –is used with ponds and reservoirs
- Closed basins and depressions are simulated
- Separate simulation of vegetative areas in residential and urban
- Simulation of point sources with service areas
- Urban retention ponds
- Impervious sediment buildup/washoff
- Shoreline reaches for more precise delivery to rivers, lakes, and estuaries
- Wildlife diversity within wetlands
- Spatial map of areas having wetland assimilation protection
- Indexing submodels for BOD, bacteria, and toxins

The overall operation of the model is managed by the ArcView-based interface. The interface allows the user to view available data, modify land use conditions, execute the model, and view results.

In order to evaluate the effect of BOD, nutrients, algae, and other oxygen demanding substances on DO processes a Water Quality Analysis Simulation Program (WASP) model was setup for this river segment. The Water Quality Analysis Simulation Program version 6 (WASP6) is an enhancement of the original WASP (Di Toro et al., 1983; Connolly and Winfield, 1984; Ambrose, R.B. et al., 1988). This model helps users interpret and predict water quality responses to natural phenomena and man-made pollution for various pollution management decisions. WASP6 is a dynamic compartment-modeling program for aquatic systems, including both the water column and the underlying benthos. The time-varying processes of advection, dispersion, point and diffuse mass loading, and boundary exchange are represented in the basic program.

Water quality processes are represented in special kinetic subroutines that are either chosen from a library or written by the user. WASP is structured to permit easy substitution of kinetic subroutines into the overall package to form problem-specific models. WASP6 comes with two such models -- TOXI for toxicants and EUTRO for conventional water quality. Earlier versions of WASP have been used to examine eutrophication of Tampa Bay; phosphorus loading to Lake Okeechobee; eutrophication of the Neuse River and estuary; eutrophication and PCB pollution of the Great Lakes (Thomann, 1975; Thomann et al., 1976; Thomann et al, 1979; Di Toro and Connolly, 1980), eutrophication of the Potomac Estuary (Thomann and Fitzpatrick, 1982), kepone pollution of the James River Estuary (O'Connor et al., 1983), volatile organic pollution of the Delaware Estuary (Ambrose, 1987), and heavy metal pollution of the Deep River, North Carolina (JRB, 1984). In addition to these, numerous applications are listed in Di Toro et al., 1983.

The flexibility afforded by the Water Quality Analysis Simulation Program is unique. WASP6 permits the modeler to structure one, two, and three-dimensional models; allows the specification of time-variable exchange coefficients, advective flows, waste loads and water quality boundary conditions. The eutrophication module of WASP6 was applied to New River in this study.

Water quality concentrations and temperature from the water quality stations near the headwaters of New River were entered as the upstream boundary conditions. Flow, depth, and velocity data predicted by the WAM model was used in the WASP models. Solar radiation data was obtained on the University of Florida Institute of Food and Agricultural Sciences, Florida Automated Weather Network world-wide-web site http://fawn.ifas.ufl.edu/. Sediment oxygen demand (SOD) can be a major contributor to low D.O. SOD measurements in the nearby Alafai River range from 1.2 to over 7 grams/square meter/day, (Measured Sediment Oxygen Demand Rates, USEPA). SOD measurements in the Ocklawaha River Basin’s Rice Creek upstream of the Georgia Pacific Mill discharge range from 1.5 to 3.0. A SOD rate of 1.5 was used in this WASP model for New River. Incremental BOD and nutrient loads were entered into WASP from the results of the WAM model.

The estimated existing nutrient and BOD loads from the watershed are summarized in Table 6. In-stream model predictions compared to observed water quality data are shown next.

Table 6: Model predicted nitrogen, phosphorous and BOD loads

Year	TN (kg/d)	TP (kg/d)	BOD (kg/d)	Annual Average Flow (m3/s)
1999	10	4	13	0.11
2000	10	4	13	0.10
2001	25	9	41	0.23
2002	23	7	26	0.23
2003	19	6	24	0.21

Table 7: Comparison of Modeled and Observed Stream Flow at USGS 02303100

Ave. monthly flow (cfs)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1964-1974 observed data	5.37	6.70	9.42	2.91	0.45	6.90	11.5	32.5	26.1	8.77	1.46	4.53
Modeled results	5.2	4.2	4.1	2.0	1.2	13.3	9.6	11.6	15.5	5.4	1.6	7.0

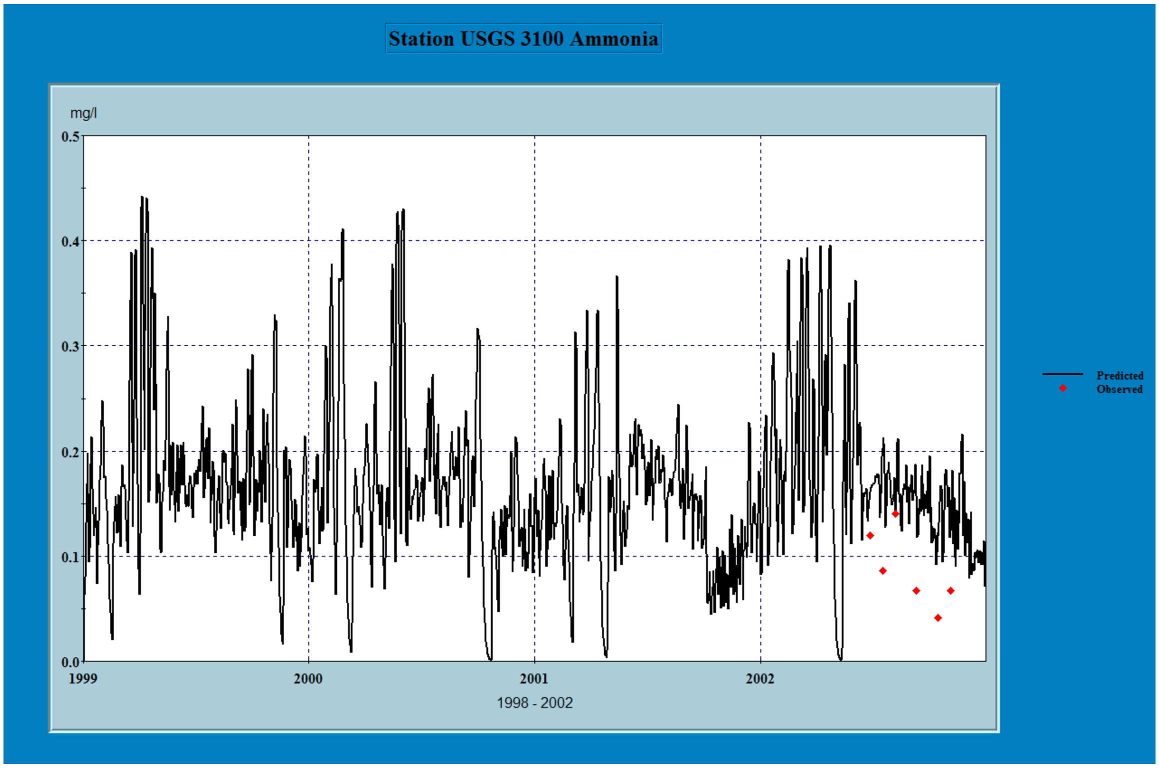

Figure 9: New River observed and predicted ammonia

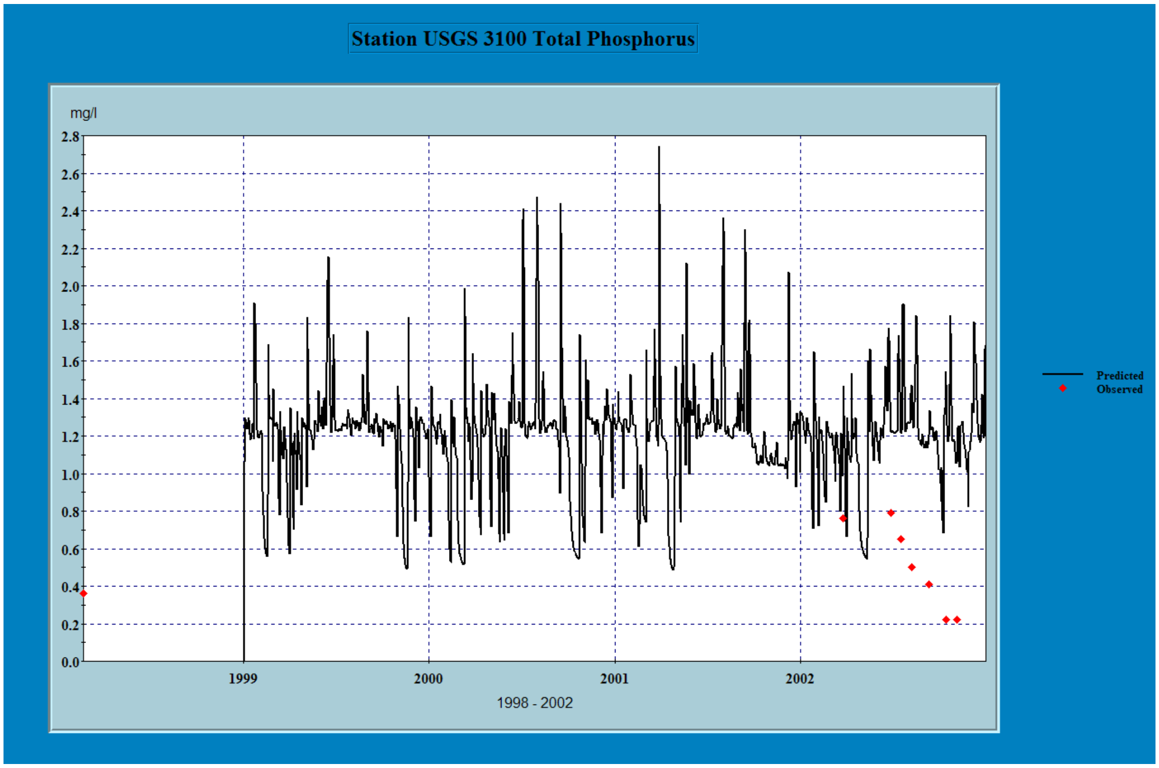

Figure 10: New River observed and predicted phosphorous

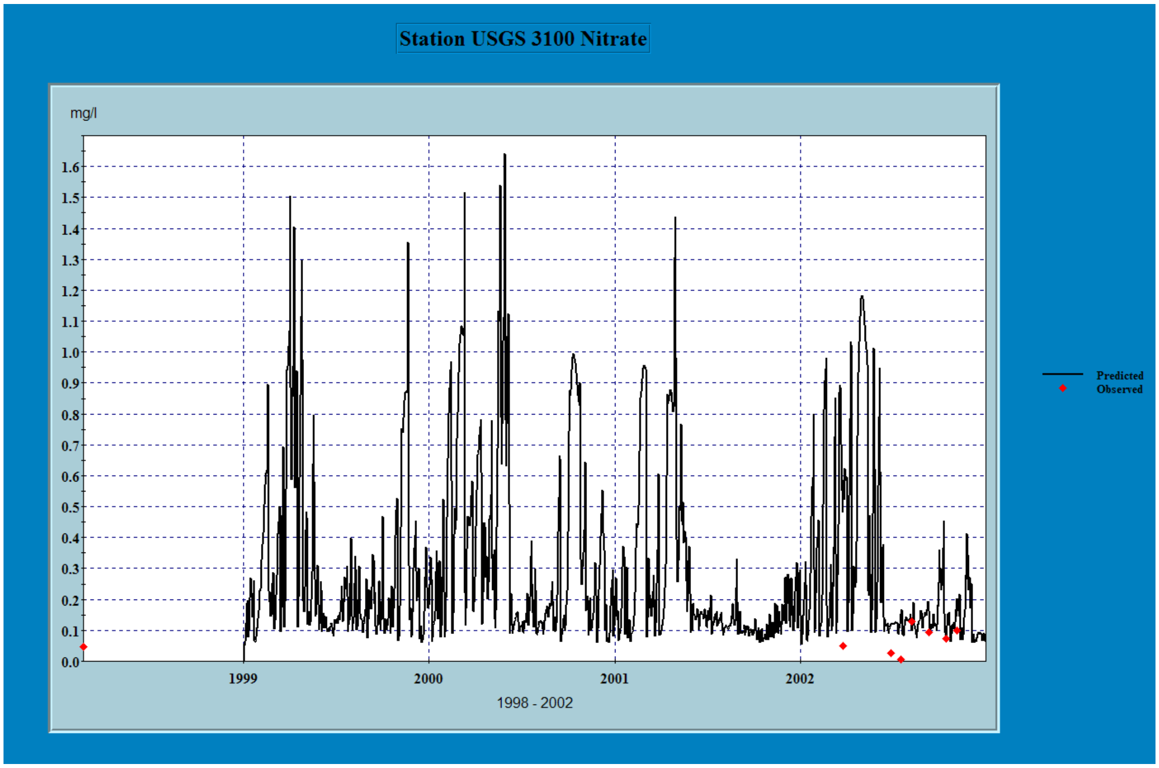

Figure 11: New River observed and predicted nitrate

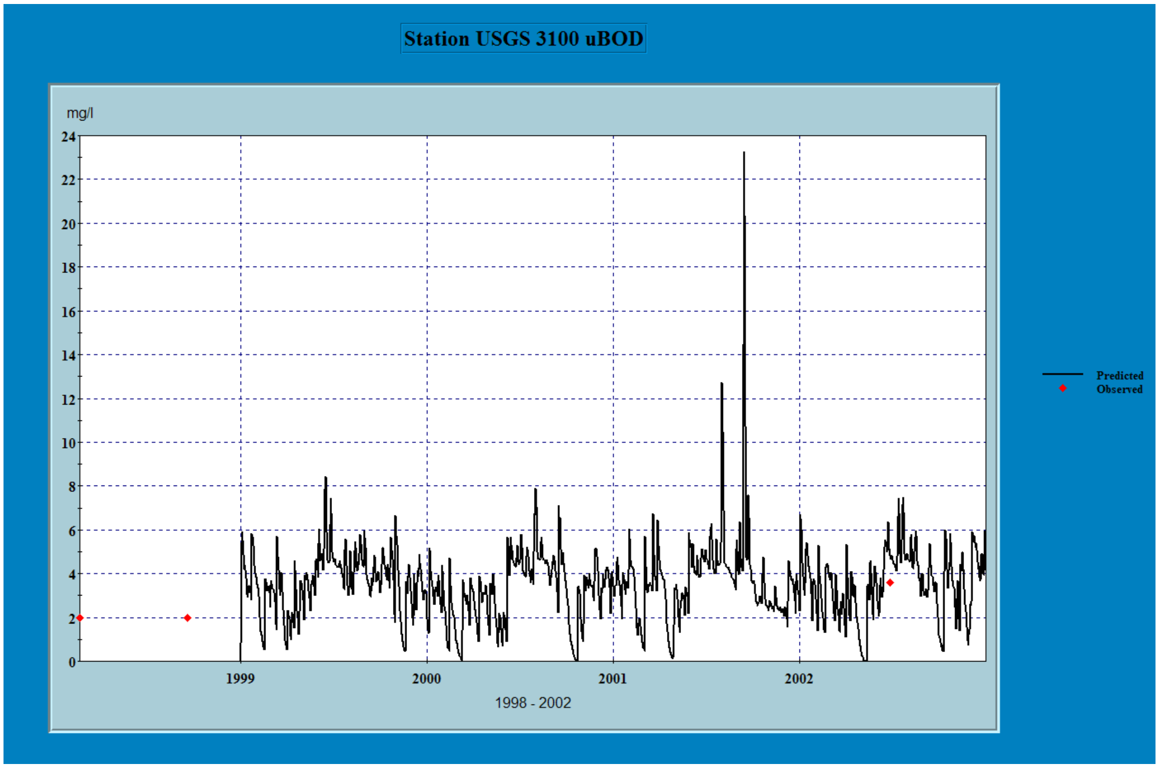

Figure 12: New River observed and predicted BOD

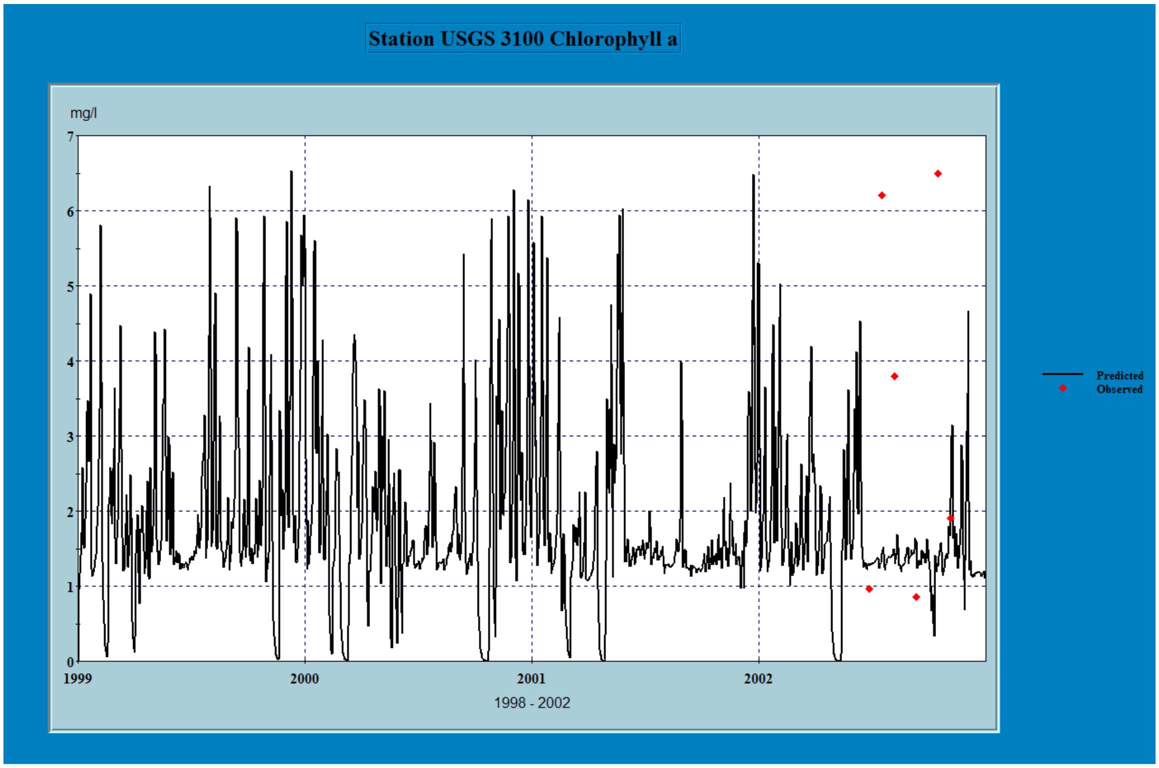

Figure 13: New River observed and predicted chlorophyll-a

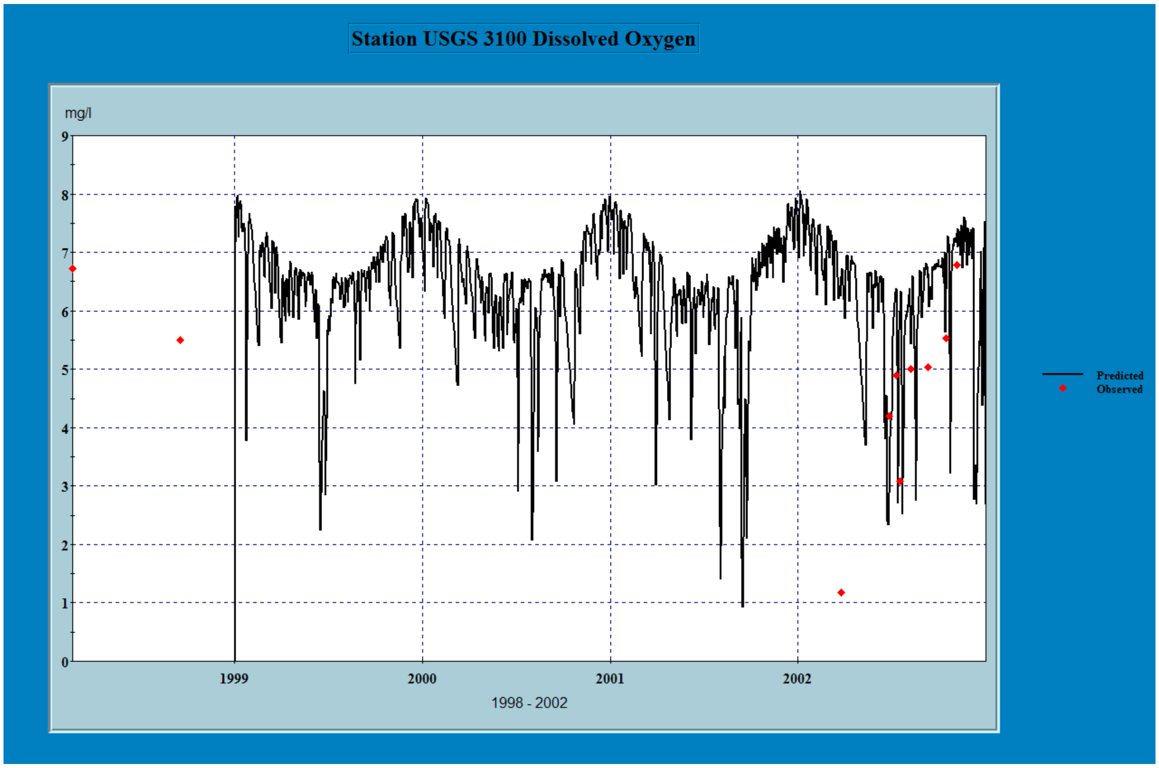

Figure 14: New River observed and predicted dissolved oxygen

The TMDLs were developed by using the model to understand the river system and determine the levels of the water quality parameters that result in attainment of the DO water quality standard. As shown in Figure 12 and again in Figure 15 BOD is relatively low, near detection limits and has little impact on the DO in this river system. These data also indicate that the DO varies little with a three-fold difference in BOD.

Nutrients can affect the DO through algae production and respiration. An excess of algae growth can imbalance the natural system and cause large DO swings from high supersaturation to low levels. Additionally, the algae population can reach a limiting level of nutrients or light and then experience a large die-off, that can then result in DO consumption and low in-stream DO. Figure 16 shows that DO in this river system is not greatly affected by algae production. Excess growth of algae may be partially prevented by the naturally dark water in this system.

Sediment oxygen demand (SOD) is another factor that can contribute to low DO. However, based on measured data from similar streams and the model results, the SOD in the stream channel is likely not high enough to cause the chronic low DO found in this river system.

After examining each of the factors that can contribute to low DO, the levels of these factors found in the New River system are not high enough to cause the chronically low DO found in this system.

The low DO in this river system is likely a result of natural processes in the wetlands and groundwater flowing into these streams. Since the watershed model is not simulating the DO processes on the watershed and wetland areas, and the receiving stream model is simulating only the processes that occur in the streams, the DO levels in the water flowing from the wetlands and groundwater to the streams is unknown. The sensitivity of the in-stream DO to the DO concentration of the water entering from the watershed can be simulated by ranging these watershed DO concentrations. Figure 17 shows simulated in-stream DO with the watershed DO set to 2 mg/l and then at 5 mg/l. This demonstrates that if the water flowing from the watershed had DO concentrations of 5 mg/l then the in-stream DO would remain above the water quality standard. Note that the few days in May during which the DO drops below 5 mg/l is due to model upsets and is ignored.

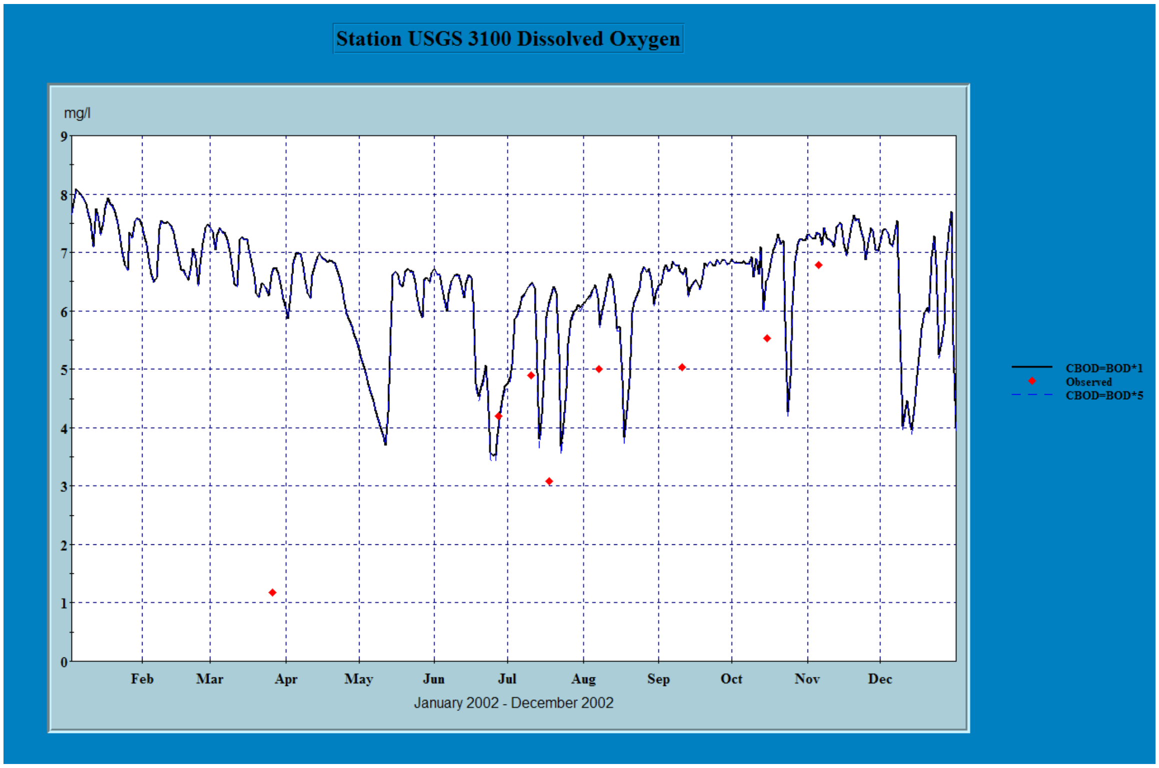

Figure 15: New River DO sensitivity to levels of BOD (BOD has little affect on in-stream DO)

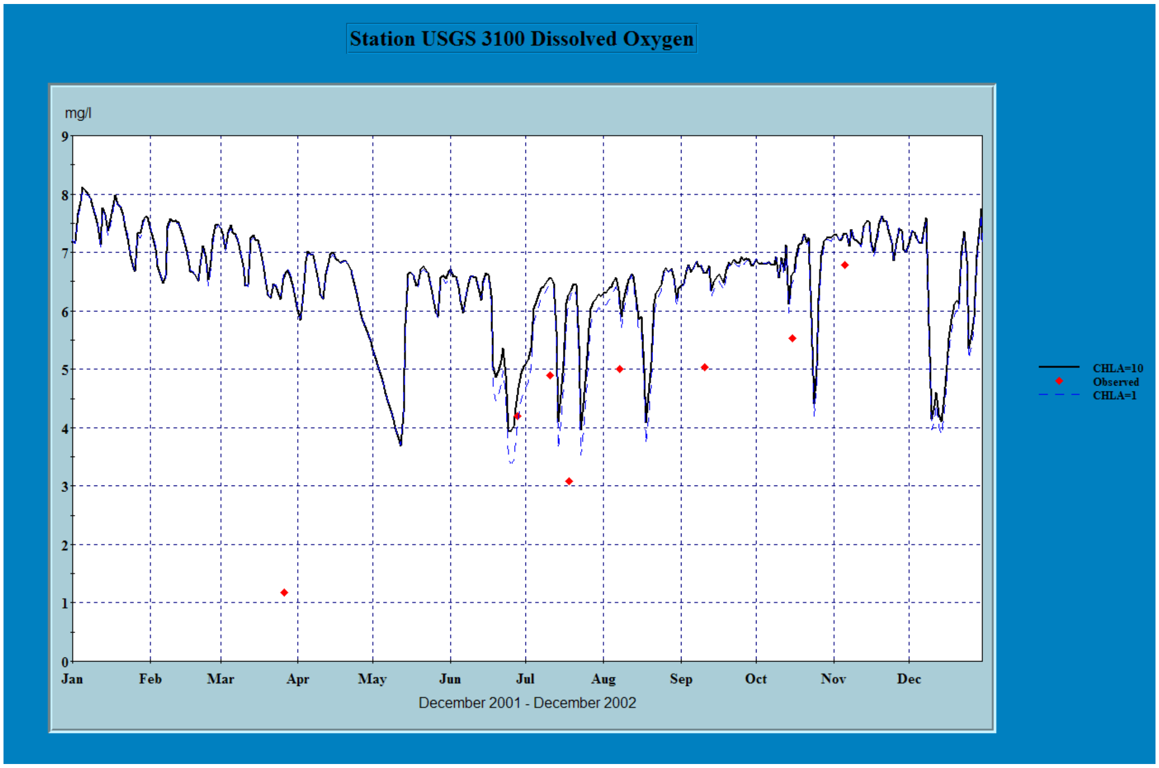

Figure 16: New River DO sensitivity to two levels of chlorophyll-a (Chlorophyll-a has little affect on in-stream DO)

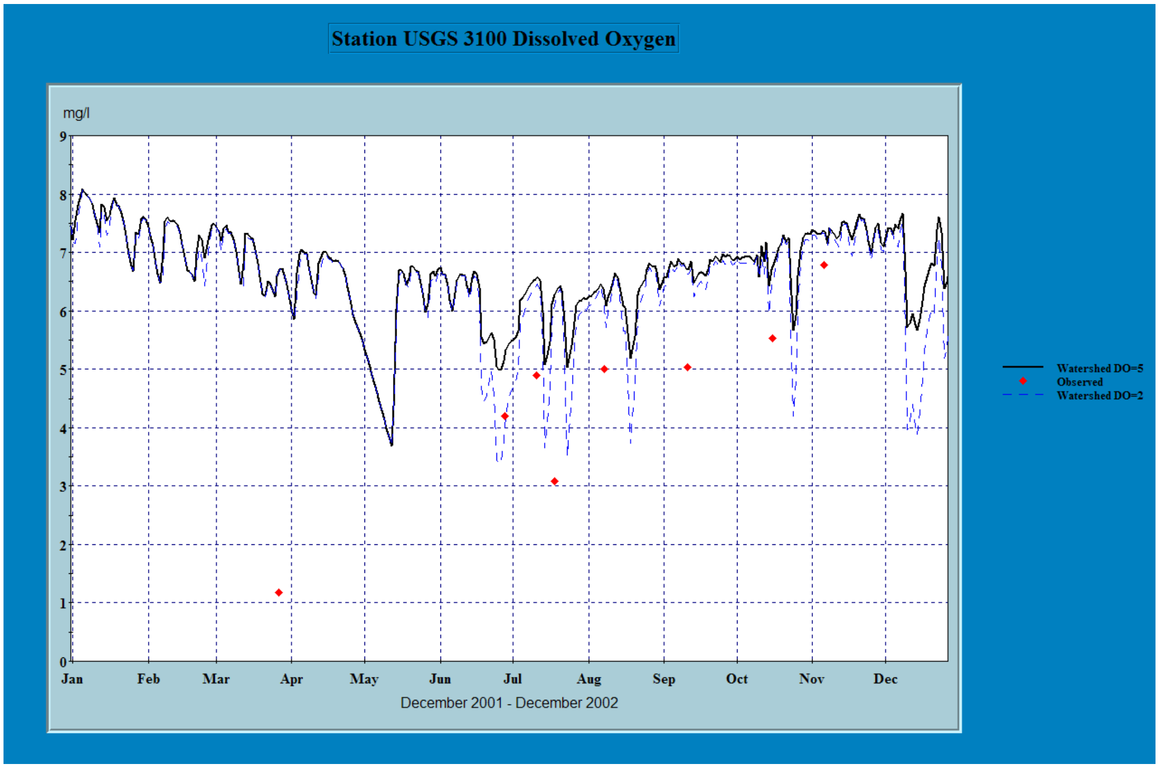

Figure 17: New River DO sensitivity to two levels of watershed DO. DO from the watershed strongly influences the minimum in-stream DO

ALLOCATIONS

The TMDL and allocation of the load is shown in . Since the low in-stream DO is a result of low DO water flowing from groundwater and wetlands, and not the result of in-stream algae, nutrient, and BOD oxygen consumption, no load reductions are specified in this TMDL report. It is recommended that loads of nutrients and BOD be maintained at current levels. The TMDL for DO is an estimate of the oxygen added necessary to achieve the water quality standard of 5 mg/l under representative flow conditions.

Expression and Allocation of the TMDL

The objective of a TMDL is to provide a basis for allocating loads among all of the known pollutant sources. A TMDL is expressed as the sum of all point source loads (Waste Load Allocations, or WLAs), nonpoint source loads (Load Allocations, or LAs), and an appropriate margin of safety (MOS), which takes into account any uncertainty concerning the relationship between effluent limitations and water quality. The equation is:

$$\textbf{TMDL} = \sum \textbf{WLA} + \sum \textbf{LAS} + \textbf{MOS}$$

TMDL Computations

The Dissolved oxygen TMDL for New River is computed as the amount of DO needed to bring the current DO levels to the standard of 5 mg/L. The average DO value for New River is 3.01 mg/L. Since this River is intermittent, zero flow part of the year, a representative flow value of 10.0 cubic feet per second (cfs) was used to calculate the TMDL. TMDL computations are as follows:

Average DO concentration needed to bring the system to 5 mg/L:

5 mg/L – 3.01 mg/l = 1.99 mg/L

Average amount of DO needed to bring New River up to 5 mg/L is calculated by multiplying the DO concentration by the flow and a factor to convert ft^3 to liters:

1.99 mg/L x 10.0 ft^3/second x 28.32 = 311.23 mg/s

Since 1 mg/s is equal to 0.19 lbs/day, the amount of DO needed to bring the system to the standard is therefore:

311.23 x 0.19 = 59.13 lbs/day

Table 8. TMDL Components for New River

WBID	Parameter	TMDL DO Added (lb/day)	LA (lb/day)	WLA[1]		MOS[2] (lb/day)
				Continuous (lb/day)	MS4	
1442	Dissolved Oxygen	65.03	59.13	0	0	5.9

Notes:

1. WLAs is broken out into two separate categories for wastewater discharges and stormwater discharges regulated under the NPDES program. There were no point sources discharging to New River. Waste load allocation from stormwater discharges is also considered zero because BOD and nutrients appear not to be sources of DO impairment in New River.
2. Margin of safety (MOS) is explicitly assigned 10% reduction in DO loading numerical target.

CRITICAL CONDITIONS

The New River TMDL for DO is based on represenative values rather than variations over a given time period. This is because the approach used to compute TMDL is based on long-term rather than short-term assessments, and that the methodology to determine the impairment in the New River was based on annual basis and therefore required data collected over a long time period.

SEASONAL VARIATION

Seasonal variation was considered by analyzing a four year period containing all seasons, wet, normal, and dry conditions.

REFERENCES

Florida Department of Environmental Protection (DEP), Basin Status Report for the Tampa Bay Tributaries Basin, DEP Division of Water Resource Management, Central District, Group 2 Basin, March 2003.

Florida Administrative Code (F.A.C.). Chapter 62-302, Surface Water Quality Standards.

Hillsborough County Environmental Protection Commission. Surface Water Quality 1996 – 2000 Hillsborough County, Florida.

National Agricultural Statistics Service (NASS), Agricultural Census for 1997, U.S. Department of Agricultural.

SWET. 2002. WAM Training Manual. Developed for EPA Region IV Training. Published by: Soil and Water Engineering Technology, Inc., Gainesville, FL.

USDA, 1997. 1997 Census of Agriculture, Volume 1, Geographic Area Series, Part 42, U.S. Department of Agriculture, National Agricultural Statistics Service. AC97-A-42, March 1999.

USEPA, 1991. Guidance for Water Quality –based Decisions: The TMDL Process. U.S. Environmental Protection Agency, Office of Water, Washington, DC. EPA-440/4-91-001, April 1991.

US Environmental Protection Agency – Region 4 Atlanta, GA, 2001, Water Quality Analysis Simulation Program (WASP) Version 6.0 DRAFT: User's Manual By Tim A. Wool, Robert B. Ambrose, James L. Martin, Edward A. Comer